Executive Summary

Johnson Creek Basin Stormwater Master Plan including Springwater and Pleasant Valley Areas

Prepared for

City of Gresham

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Executive Summary

Introduction

The City of Gresham prepared stormwater master plans for the Johnson Creek drainage basin and the future annexation areas of Springwater and Pleasant Valley. This executive summary consolidates the highlights of those interrelated plans, which were published as follows:

- *Draft Johnson Creek Stormwater Master Plan,* 2003, prepared by Pacific Water Resources, Inc., in association with CH2M HILL, Dennis O'Connor, and Ash Creek Forest Management. This report was subsequently annotated by the City of Gresham in 2005.
- *Springwater Stormwater Master Plan,* 2005, prepared by HDR Engineering. Also the related *Springwater Natural Resources Report* of the *Springwater Community Plan*, 2005, prepared by the City of Gresham, Community & Economic Development Department—New Communities and Annexation and Department of Environmental Services.
- *Pleasant Valley Stormwater Master Plan*. 2004. Prepared by CH2M HILL with HDR Engineering, GreenWorks, P.C., Natural Resource Planning Services, Inc., and ECONorthwest.

Readers are directed to these reports for details about the development of the individual stormwater master plans. The areas covered by these plans are shown in Figure ES-1.

Master Planning Goals

The primary goals of the plans were to:

- Protect the public's safety, health, and property through flood control measures
- Reduce the discharge of pollutants in stormwater runoff to the maximum extent practicable
- Protect and maintain the natural functions and value of the area's surface waters.

Recommendations

To address the master planning goals, the City of Gresham analyzed existing and future land use conditions and identified the stormwater facilities that are needed in the Johnson Creek, Springwater, and Pleasant Valley study areas. The resulting program of recommended Capital Improvement Plan (CIP) projects is summarized in Table ES-1.

TABLE ES-1
Total Stormwater CIP Project Cost Summary

Area	Total CIP Project Costs	Types of Projects
Johnson Creek	$5,643,688	6 culvert improvements 15 pipe improvements 9 natural resource projects
Springwater	$47,329,200	17 regional stormwater management facilities 13 culverts 34 swale culverts 41,000 linear feet of drainage channels 96,000 linear feet of 8-foot swales 7,700 linear feet of 10-foot swales 10 natural resource projects
Pleasant Valley	$12,859,965	11 regional stormwater management facilities 22 culvert swale crossings 72 swale/pipe systems
Gresham Total	**$65,832,853**	
Springwater	$4,819,386[a]	3 regional stormwater management facilities 1 swale culvert 5,000 linear feet of 8-foot swales 1 natural resource project
Pleasant Valley	$7,074,930[b] $7,755,489[c]	4 regional stormwater management facilities 1 culvert swale crossings 16 swale/pipe systems
Area Total	**$85,482,658**	

[a]Projects within the Springwater Planning Area to be in City of Damascus and Existing City Brickwork site
[b]Projects within the Pleasant Valley Planning Area to be in City of Happy Valley
[c]Projects within the Pleasant Valley Planning Area to be in City of Portland

Refer to the Capital Improvement Plan section at the end of this executive summary for details about the CIP projects and their locations.

Study Area Characteristics

Johnson Creek

The Johnson Creek study area encompasses 6.92 square miles of drainage area within the City of Gresham. The Johnson Creek headwaters begin in the foothills of the Cascade Mountains in rural Clackamas County. The creek flows north and west before entering Gresham at the southeast portion of the City. The entire Johnson Creek basin drains approximately 54 square miles, but the study area is limited to the Johnson Creek drainage within the Gresham City limits. The study area is roughly bounded by Division Street on the north, Burnside Road / Highway 26 on the east, and the City limits to the south and west. Most of the study area is south of Powell Boulevard and west of 242nd Avenue.

Approximately 60 percent of the study area consists of developed lands. The single greatest land use (35 percent) is single-family residential. Roads represent 13 percent of the study area. Commercial land uses occupy less than 4 percent of the study area. Multi-family residential and industrial land uses occupy less than 2 percent and 1 percent of the study

Figure

ES-1 Basin Site Map
11 x 17 color

Front

back

area, respectively. Approximately 29 percent of the study area has been estimated to be non-developable due to steep slopes, riparian buffers, and floodplains.

The topography varies from relatively flat areas along Johnson Creek and generally to the north to very steep areas generally south of Johnson Creek and surrounding Gresham Butte, with rolling hills on the western part of the City.

Springwater

The Springwater area, which encompasses approximately 2.7 square miles, was recently added to Gresham's jurisdiction for future economic development and growth. It has state-wide significance as a possible site for large-scale industry.

The Springwater Community Plan Area is located along State Highway 26 immediately southeast of Gresham, in the upper portion of the Johnson Creek Watershed. From the outlet of the Springwater Community Plan Area, Johnson Creek drains approximately 15.4 square miles via three major drainage basins: mainstem Johnson Creek, Johnson Creek North Fork, and Sunshine Creek. The planning area comprises a variety of different land covers, including significant amounts of forest, agricultural lands, and rural residential areas.

Pleasant Valley

Pleasant Valley is an approximately 2.4-square-mile community planned for the area east of Portland and southwest of Gresham. This area was brought into the regional urban growth boundary in 1998. Since that time, significant planning efforts and resources have been applied to establish processes to allow low impact development to occur. Pleasant Valley is a rural area where historical drainage practices have significantly damaged watershed health, especially in riparian areas. The envisioned stormwater drainage system will be an important component in the community's design.

The Pleasant Valley study area is located immediately southwest of Gresham in the Kelley Creek subbasin of the Johnson Creek Watershed. The subbasin drains approximately 5 square miles of a northwest sloping area with land cover including forest, agricultural lands, and rural residential areas.

While this master plan includes the entire Kelley Creek Watershed, the recommendations and improvements analyzed are limited to within the Pleasant Valley Plan District boundary; regional improvements outside the district boundary were not developed.

Johnson Creek Analysis

The existing City of Gresham stormwater conveyance system was evaluated using a computer simulation model to develop design flows that were routed throughout the system. Current land uses and City zoning classifications were then used to evaluate how the stormwater conveyance system functions under existing and future development conditions. A separate computer simulation model was used to evaluate the long-term stormwater pollutant runoff response of existing land use development. Based on the results of these various model simulations and the field reconnaissance of natural resource areas, site-specific recommendations were made and CIP projects were developed.

The planning criteria used for assessing hydraulic deficiencies throughout the closed pipe and culverted storm drainage systems of the Johnson Creek study area were as follows:

- Major closed pipe collectors and culverted crossings whose drainage areas are 250 acres or less should be able to convey peak discharges from a 10-year return interval event.
- Closed pipe and culverted systems that drain greater than 250 acres should be able to convey peak discharges from a 50-year return interval event. The 50-year event is also specified for those closed pipe and culverted systems that flow under arterial streets.
- Surcharged conditions for pipe systems and culverts are acceptable only for demonstrating the adequacy of the conveyance system to convey the peak runoff for the required 50-year design storm provided that the flow is contained within the defined conveyance system elements and the hydraulic grade line (usually taken as the water surface) does not exceed the elevation of the roadway subgrade. For master planning studies, the City interprets the elevation of the roadway subgrade to be 2 feet below the manhole rim. Therefore, if the surcharged water surface is 2 feet or more below the manhole rim, the pipe is not considered to be hydraulically deficient.
- Surcharges during the 10-year event are allowed provided the water surface remains 2 feet or more below the manhole rim. In addition, if pipe replacement is the recommended solution to the identified hydraulic deficiency, the replacement pipe is also allowed to surcharge, provided once again that the water surface is 2 feet or more below the manhole rim.

Water Quantity Modeling

To help the City understand the hydrologic impact of existing and potential future development within its incorporated boundaries, an XP-SWMM hydrologic model of the 20.4-square-mile local portion of the Johnson Creek watershed was developed, with greater detail within the 6.92-square-mile study area.

The XP-SWMM model forms the basis of ongoing surface water master planning efforts for watershed areas located upstream of the existing City limits, which are expected to be developed in the near future. The XP-SWMM model was calibrated to reproduce the peak flood flows along the mainstem of Johnson Creek that were published in 1998 as part of the City of Portland's more comprehensive modeling effort for the entire Johnson Creek watershed. Referred to as the 1998 HEC-1 model development, it involved a detailed model calibration to several flood hydrographs observed at two different locations downstream of Gresham for up to five historic flood events, including the record November 19, 1996, flood.

The calibrated model was updated to include estimates of future development within the planning area based on the City's Comprehensive Plan and an analysis of developable lands within that plan. Subbasin peak flows were simulated for the 2-, 5-, 10-, 25-, 50-, and 100-year return interval floods under both existing and planned future conditions. The XP-SWMM model was used with the City's drainage planning and design criteria to identify the conveyance problems or hydraulic deficiencies within the system with a special emphasis on the 10- and 50-year return interval flood flows as specified in the criteria.

Gresham's Peak Flow Impact on the Johnson Creek Mainstem

One of the issues that the City wanted to address was the potential increase in peak flood discharges on the Johnson Creek mainstem due to future development within the study area. To evaluate this issue, the XP-SWMM model was executed for existing and planned future land use conditions.

The model output showed that for most of the flood events examined, future development in the study area will have a relatively small impact on increased mainstem flow. The greatest impact appears to be on the more frequent floods like the 5-year event. The model output suggests that the design of future facilities should concentrate on providing significant flow reductions for the more frequent floods such as the 5-year event and not the less frequent events, unless hydraulic deficiencies still exist within the tributary systems downstream of the new development.

Stormwater Management Plan

The stormwater master planning process evaluated the following management strategies for the study area:

- Increase conveyance or capacity of pipes, culverts, and open channel to carry peak flows.
- Increase detention storage both locally and regionally to delay or reduce peak flows downstream of the storage location.
- Increase the in-stream storage available or change the threshold stream flow in which the available floodplain storage starts to be utilized.
- Divert high stream flows away from or around a capacity problem to place downstream where greater capacity exists.
- Acquire properties that flood frequently, as they become available.
- Reduce and/or disconnect the storm sewer system from the impervious cover of the watershed.
- Take no action, thus maintaining the existing system.

Because of the generally steep topography found within the study area, the use of regional detention was severely limited. The few detention sites that exist on the various tributary waterways are located at or near their confluences with the mainstem of Johnson Creek and as a result would provide flow reduction benefits for relatively short reaches of tributary systems that they would be designed to serve. In addition, the relatively small amount of flood storage available at any given site would not significantly affect the peak flows on the mainstem of Johnson Creek either. The well defined, incised, and steep stream channels generally found throughout the study area also makes it infeasible to use in-stream storage and high flow diversion for downstream flow reduction.

Based on input from City staff, few properties within the study area are known to flood. Although the disconnection or reduction of impervious cover can be an effective strategy for flow reduction from future development, the implementation cost for retrofitting existing urbanized areas would be expensive because the overall effective impervious area of the study area is already estimated at 29 percent. The City should modify new development standards to require reduction of effective impervious surfaces for new development.

To solve the hydraulic deficiencies identified by the modeling, pipe and culvert projects were recommended.

Water Quality Modeling

The City has already developed and implemented a National Pollutant Discharge Elimination System stormwater management plan pursuant to Section 402 and 405 of the Federal Clean Water Act. The *Johnson Creek Stormwater Master Plan* complements and augments this existing plan. Water quality modeling was performed to do the following:

- Develop more accurate estimates of average annual pollutant load and concentrations
- Evaluate the pollutant reduction benefits of existing maintenance practices
- Evaluate the pollutant reduction benefits of increased maintenance practices
- Identify other available water quality improvement techniques and evaluate their potential pollutant reduction benefits

Stormwater Pollutant Load Modeling

Stormwater quality planning was performed using the SIMplified Particulate Transport Model (SIMPTM). This is a continuous stormwater quality model that simulates the urban sediment and associated pollutant washoffs from multiple rainfall events over a long period of time.

The SIMPTM model results were verified against data published in 1997 by the Oregon Association of Clean Water Agencies and the City's land use based monitoring data. Average annual pollutant event mean concentrations (EMCs) simulated by SIMPTM were compared to the published average site median EMCs observed from 1990 to 1996 at several single-family residential and commercial sites throughout western Oregon and the median EMCs observed from 1996 to 1998 at two City of Gresham land use monitoring sites. The average EMCs estimated by SIMPTM for the surveyed land use areas in Gresham were all within the range of observed site median data for similar land use areas throughout western Oregon and/or the range of observed values found in the more recent City data.

Load Reductions from Maintenance Practices

The SIMPTM model was used to estimate the pollutant reduction benefits associated with the City's cleaning practices for both streets and sediment trapping catch basins or man-holes. The modeling results, however, were considered unreliable because they dramatically underestimated the potential pollutant reduction benefits of street sweeping in comparison with similar studies. This result was judged to be unreasonable. Continuance of the current sweeping program is recommended until further study determines whether increased sweeping would be worthwhile.

The SIMPTM model was also used to simulate the pollutant reduction benefits associated with catch basin cleaning. The modeling estimated that annual catch basin cleaning in single-family residential areas reduces total suspended solids washoff by approximately

45 percent. The City should continue cleaning catch basins annually. As funding is available, it may be appropriate to evaluate increasing the cleaning frequency for catch basins with sumps.

Water Quality Management Plan

The potential water quality benefits of three categories of water quality improvement techniques were evaluated. The first two categories (i.e., natural resources enhancements and regional water quality projects) dealt with the stream and its associated riparian corridor. The third category (retrofit urban storm systems) dealt with techniques applied to the storm drainage systems that are tributary to the streams themselves.

Natural resource enhancements are applied along or within the stream channel to reduce sediment and associated pollutants that originate near or in the stream channel. Because of the steepness of the stream channels throughout the study area, many of these enhancements were used to address erosion and scour problems that were discovered as part of the field reconnaissance that was conducted. Nine natural resources enhancement projects are recommended as part of the stormwater plan.

Regional water quality projects were evaluated for treatment of stormwater from large areas. As a result of the generally steep topography throughout the Johnson Creek study area, it was not practical to site regional water quality projects in the area.

Evaluation of retrofits to urban storm systems focused on stormwater inlets. Very few of the stormwater inlets observed throughout the single-family residential areas surveyed were constructed with sumps or traps. Given the potential water quality benefits associated with sediment-trapping catch basins and their periodic cleaning, it is recommended that the City should consider implementing a catch basin retrofit program that connects two or more of these self-cleaning inlets to a single sedimentation manhole throughout the Johnson Creek study area. Studies by others have shown that the cost of cleaning on a pollutant removal basis was lower for sedimentation manholes than for smaller sediment trapping catch basins. The City should implement a sedimentation manhole retrofit program.

Springwater Analysis and Modeling

A master planning analysis was performed for existing and future land use conditions to identify potential stormwater facilities specifically required for the Springwater Community Plan Area, including portions of Hogan, Botefuhr, Brigman, McNutt, Sunshine, Badger and Johnson creeks. The system analysis was guided by a number of evaluation criteria. Foremost among these criteria were the following:

- Existing stream crossings are required to convey either the 100-year or 10-year nuisance peak flow with at least 1 foot of freeboard between the water surface and the roadway elevations.
- Post-development runoff from the 2-year event will be limited to 50 percent of the pre-development rate via impervious area reduction and onsite or regional management facilities to meet channel forming (geomorphic) flow criteria.

- Regional stormwater management facilities will be multiuse; providing geomorphic storage (limit the post-development 2-year runoff peak to half of the existing condition rate), flood control (limit the post-development nuisance storm peak flow to the existing condition rate), and water quality treatment (storing and treating the entire contributing water quality volume (1/3 of the 2-year event)).
- Conveyance facilities (swale, drainage channels, etc.) are to be designed to convey the nuisance storm.
- Conveyance of the 100-year storm from onsite development to public infrastructure is to be provided via overland flow. The finished flood elevation of structures adjacent to the 100-year overland flow path is to be set a minimum of 1 foot above the base flood elevation.

Coordination with the Other UGB Expansion Areas in Johnson Creek Watershed

The Springwater master planning study is part of a broader expansion of the eastern portion of the region's urban growth boundary in Clackamas and Multnomah counties in the general area of Damascus, Boring, and Gresham. The Springwater area itself is made up of the Springwater Community Plan Areain Multnomah County and the adjacent area of the City of Damascus planning area in Clackamas County. Because the City of Damascus area has yet to be master planned to this level, a summary of the stormwater planning assumptions for the City of Damascus area have been developed and shared with Clackamas County's Water Environment Services Agency and the City of Damascus (via its consultant). The City of Damascus is currently reviewing options for service providers. Once the decision on the service provider is made, an intergovernmental agreement identifying common goals and planning criteria should be considered to better ensure the mutual success of the entire basin as it develops.

Water Quantity Modeling

The primary objectives of the water quantity modeling for the Springwater Community Plan Area were to:

- Construct a model that accurately represents the existing stormwater system within the Springwater boundary.
- Calibrate and verify the model to actual rainfall events based on available measured stream flow.
- Utilize a land use-based method to estimate runoff under current and future development plans.
- Establish a suitable procedure for modeling onsite controls and low impact development practices.
- Evaluate the existing stormwater infrastructure.
- Locate, size, and assess the performance of new stormwater management facilities.

The level of urbanization and the variability of land use conditions within the Springwater planning boundary can significantly impact runoff estimations. Currently, much of the basin is composed of undeveloped agricultural, single-family, or rural residential lands, but planning goals indicate that significant urbanization will occur within portions of the watershed, thus increasing the magnitude, volume, and concentration of generated stormwater runoff.

As a foundation for the evaluation of the planning area, hydrologic and hydraulic analyses of existing and future system conditions were performed. The purposes of these analyses were to evaluate the impacts of development and compare them to present day conditions. A set of CIP projects with associated onsite low impact development requirements was developed that collectively shows no increase in flooding and no degradation of the downstream channel system.

Water Quality Modeling

A representative water quality model for the creek system, the swale and drainage channel conveyance network, and the regional detention facilities was developed to analyze a variety of different water quality constituents, stormwater facilities, and best management practices. For these purposes, a water quality model was built to predict pollutant concentrations and loads for the Upper Johnson Creek Watershed and the Springwater Community Plan Area using the City of Gresham "water quality" design storm (approximately a 6-month, or 1/3 of the 2-year, return period storm). The model simulation is intended to provide approximate concentrations to identify potential pollutant "hot spots" within the basin, illustrating the differences between various development scenarios.

The primary objectives of the water quality modeling for the Springwater planning area were as follows:

- Construct a model that approximately represents the quality of the existing stormwater system for the Johnson Creek Watershed and Springwater boundary.
- Determine appropriate water quality concentrations associated with the different land use categories and suitable best management practice (BMP) removal efficiencies to account for onsite controls and low impact development (LID) strategies.
- Evaluate the existing and proposed systems and determine appropriate regional facility requirements to keep net increase of pollutants at or below zero.

The Clean Water Act regulates the quality of surface waters through numerous programs. Section 303(d) of the act provides a mechanism to list waters that are considered water quality impaired. Johnson Creek, the primary receiving water body in the Springwater Community Plan Area is on the 303(d) list for a number of pollutants. Consequently, the goal of this water quality analysis was to show no net increase in pollutant loads or concentrations as a result of the urbanization of the planning area.

In comparing the future condition scenarios, it is apparent that the regional water quality facilities and the onsite LID practices will play important roles in mitigating for development. Model results for the future onsite controls with regional water quality facilities indicate that for each constituent, peak concentrations and total loads will be at or below existing levels. Thus, no net increase in pollutants is predicted. These results also reinforce the need not only to construct the regional facilities and implement the LID practices, but to adopt and pursue a maintenance program that preserves their original design function.

Pleasant Valley Analysis

A master planning analysis was performed for existing and future land use conditions to identify stormwater facilities specifically required for the Pleasant Valley Plan District (PVPD) and the Kelley Creek Watershed.

Stormwater master planning was accomplished using a number of system analysis evaluation criteria. Foremost of these criteria was the design storm recurrence interval and its impact on system analysis. The five design storms used in the *Pleasant Valley Stormwater Master Plan* were 1/3 of the 2-year (water quality storm), 1/2 of the 2-year (channel forming event), 2-year, 10-year nuisance storm, and 100-year.

The following design criteria were used to evaluate the conveyance infrastructure:

- Green street swales for connector and local roadways are designed to convey the nuisance storm. Due to swale geometry constraints, a freeboard criterion is not included.
- Green street swales for collector and arterial roadways are designed to convey the 100-year design storm. Due to swale geometry constraints, a freeboard criterion is not included.
- Public swales outside the green street right-of-way (e.g., regional management outfalls, diversion channels, etc.) are designed to convey the 100-year design storm with 1 foot of freeboard.
- Green street culverts and stream crossings for connector and local streets and miscellaneous storm drain piping systems are designed to convey the nuisance storm.
- Green street culverts and stream crossings for collector and arterial roadways are designed to convey the 100-year design storm.

Planning and design criteria for new stormwater infrastructure were grouped into two categories: onsite facilities and public infrastructure. Onsite facilities are a result of private development occurring within the PVPD and occur at the lot and subdivision scale, while the public infrastructure improvements, such as regional management facilities, are associated with the CIP program.

Hydrologic and Geomorphic Analysis

A hydrologic and geomorphic analysis of Kelley Creek was performed to identify a dominant channel-forming flow event and thresholds to reduce the potential for further aggravation of the in-stream erosion problems. These thresholds were then compared with other stormwater release rate requirements in the Pacific Northwest to define a project-specific release rate requirement (both peak flow and flow duration) for the planned regional management facilities and onsite quantity controls in the Kelley Creek basin (or PVPD).

Based on a combined assessment of the channel-forming flow analysis and the stormwater release requirements from other agencies/municipalities in the Pacific Northwest, recommended release rate thresholds for Pleasant Valley are as follows:

- Limit the post-developed site peak discharge to pre-developed rates for all storm events with a recurrence interval less than or equal to 25 years.
- Limit the 2-year post-development peak flow to the pre-development channel-forming flow (50 percent of the 2-year flow).

The recommendations are conservative, as they are more stringent than those the City of Gresham currently requires. However, they are consistent with Portland's *Stormwater Management Manual* (Portland, 2002 and 2004). The more stringent recommendations are consistent with the PVPD objectives to mimic natural hydrologic processes, minimize impacts to local natural resources, and protect downstream resources, including those in the Johnson Creek basin below the Kelley Creek confluence.

Environmentally Sensitive/Restoration Areas

In the Pleasant Valley area, the *Proposed Pleasant Valley Natural Resources Protection Plan* (Gresham and Portland, 2004) provides the foundation for protecting natural resources and conserving scenic and historic areas and open spaces.

The *Pleasant Valley Concept Plan* (Pleasant Valley Project Partners et al., 2002) and the associated series of community forums identified significant natural resource areas to be preserved, enhanced, and restored. This green space system became known as the Environmentally Sensitive/Restoration Area (ESRA) subdistrict. The ESRA serves as a central organizing feature of the plan. Policies were developed to concentrate development on buildable lands and limit placement of utilities, roads and road crossings, and buildings in the ESRA sites as part of a strategy to protect habitat and species, water quality, and the aquifer.

In addition to their role as receiving waters, the ESRA sites help to reduce flood peaks for the nuisance, 5-year, and 2.5-year storms. Initial modeling shows that the 100-year flood footprint stays well within the ESRA with the implication that the ESRA is a flood management tool. The flood peak reduction benefits of properly functioning ESRA sites mean that regional facilities do not need be sized to manage the 100-year flood, providing significant cost savings.

Opportunities for maintaining and enhancing the natural stormwater infrastructure and the stormwater management functions of the ESRA were integrated into Pleasant Valley Stormwater Master Plan.

Water Quantity Modeling

A key element in this master planning process was the development of a hydrologic and hydraulic model of the watershed and its natural and man-made stormwater system. The primary objectives of the water quantity modeling were to:

- Construct a model that accurately represents the existing stormwater system for the Kelley Creek basin and the PVPD.

- Calibrate and verify the model to actual rainfall events based on measured streamflow rates within the system.
- Determine an appropriate method to estimate runoff using current and future land use plans.
- Establish a suitable procedure for modeling onsite controls and LID practices.
- Evaluate the existing infrastructure.
- Locate, size, and assess the performance of new stormwater management facilities.

The modeling tools—MIKE-11 NAM for hydrology, MIKE-11 HD for hydraulics, and MIKE-11 AD for water quality—were chosen for their capabilities for predicting the quantity and quality of runoff, evaluating the hydraulic performance of existing facilities (channels, culverts, etc.), designing proposed facilities, and analyzing LID and BMP strategies or onsite controls.

Initial development of the MIKE-11 Kelley Creek Watershed model was performed by DHI, in support of the *Pleasant Valley Implementation Plan Report* (Otak, 2003b); this model was used as the initial point of model development. Investigations of the existing system infrastructure focused on culvert capacity, roadway overtopping, water quality concentrations, and overall system discharge. The system analysis for the future land use conditions and associated CIP alternatives included an evaluation of roadside swales and culverts, stream crossings, regional management facilities, and overall system discharge.

The models were run for five different precipitation events and four different land use conditions, for a total of 20 model runs. The four different land use conditions included existing conditions, plus future base, representing full buildout in the PVPD but without mitigation; future onsite controls, representing full buildout in the PVPD with LID practices as onsite mitigation; and future onsite controls and regional water quantity facilities, which added water quantity facilities to the future onsite controls model.

The analysis results indicate that for the nuisance storm and 100-year storm events, a combined solution including regional management facilities and onsite LID or green stormwater management practices, is necessary to meet the stormwater management goals for the Kelley Creek basin.

Water Quality Modeling

A second key element in this master planning process was the development of a representative water quality model for the main channel system that is capable of analyzing a variety of different water quality constituents, stormwater facilities, and BMPs. To these ends, a water quality model was built to predict pollutant concentrations and loads for the Kelley Creek Watershed using the City of Gresham "water quality" design storm (approximately a 6-month return period storm). The model simulation is intended to provide approximate concentrations to identify potential pollutant "hot spots" within the basin, illustrating the differences between the different land use alternatives.

The primary objectives of the water quality modeling were as follows:

- Construct a model that approximately represents the quality of the existing stormwater system for the Kelley Creek Watershed and the PVPD.
- Calibrate and verify the model to actual water quality measurement.
- Determine appropriate water quality concentrations associated with the different land use categories and suitable reduction factors to account for onsite controls and LID strategies.
- Evaluate the existing and proposed systems and determine appropriate regional facility requirements.

Water quality was evaluated in the Kelley Creek Watershed using the MIKE-11 AD module. This tool was combined with the MIKE-11 NAM module for hydrology and the MIKE-11 HD module for hydraulics to predict the pollutant concentrations and loads associated with the different land use scenarios. EMC values were determined for residential, commercial, transportation, open space, agricultural, and industrial land use categories.

An existing conditions water quality model was constructed to run simultaneously with the existing hydrologic and hydraulic models and incorporated the EMC concentrations. This model served as a basis for comparison of the subsequent future conditions analysis and serves to indicate the effectiveness of the onsite controls (LID strategies or BMPs) and the regional water quality facilities.

Future land use conditions were divided into three scenarios: (1) future base, representing full buildout in the PVPD but without mitigation; (2) future onsite controls, representing full buildout in the PVPD with LID practices as onsite mitigation; and (3) future onsite controls and regional water quality facilities, which added water quality facilities to the future onsite controls mode.

Based on the results of the water quality analysis, phosphorus was determined to be above the water quality threshold. Two other constituents, lead and copper, also exceeded the concentration limits at various locations or “hot spots” in the system, but were not excessive. It is important to note that the existing conditions model also produced pollutant concentrations for phosphorus and lead that exceeded the thresholds. The two remaining pollutants, zinc and total suspended solids, were not predicted to exceed the thresholds.

In comparing the three future condition scenarios, it is apparent that the regional water quality facilities and the onsite controls play important roles in mitigating for development. The results also reinforce the need not only to construct the regional facilities and implement the LID practices, but to adopt and maintain a program that preserves their original design function.

Capital Improvement Plan

The recommended CIP projects for the Johnson Creek, Springwater, and Pleasant Valley areas are summarized in Tables ES-2, ES-3, and ES-4, respectively. The planning level cost estimates shown in Tables ES-1 through ES-4 were developed to determine feasibility, evaluate alternate solutions, and establish financial need. These estimates were based on available planning and engineering data and limited cost information and did not involve detailed data gathering or analysis.

The CIP project locations for Johnson Creek are shown in Figures ES-2 and ES-3. The CIP project locations for Springwater are shown in Figures ES-4 and ES-5. The Pleasant Valley CIP project locations are shown in Figures ES-6 and ES-7.

Within Pleasant Valley and Springwater areas, over 548 acres of regulated lands, known as ESRAs, have been identified for protection from urban development. Within these ESRAs, limited development will be allowed and managed in a way that is compatible with the goals of natural resource protection. Properly constructed, this development could lend itself to habitat enhancement. The requirements for limited development are stipulated through the development code. However, the only way to ensure full protection and restoration or enhancement of these areas is to undertake public ownership. The cost for full public ownership is estimated to be over $26 million. Although effective, this approach needs to be evaluated by the City to determine if it is desirable, and to identify potential funding sources.

Johnson Creek

Initial modeling results and associated recommendations for improvements were provided to Gresham staff for their review. This project list was then screened by City staff and recommended CIP projects extracted from the original list. The screening criteria included historical flooding, potential for upstream development, and land use zoning impacts. The full list of modeled deficiencies and the recommended CIP projects are included in the *Annotated Johnson Creek Stormwater Master Plan* report; however, only the recommended CIP projects are included in Table ES-2 of this executive summary.

Springwater

The public stormwater infrastructure projects for the Springwater area were organized according to an implementation schedule generally based on a west to east and north to south annexation strategy. The CIPs were bundled according to this annexation strategy into 17 subareas. Also, projects scheduled for construction during later annexation phases but required for conveying or treating stormwater from an earlier annexation area were identified. This established a full conveyance and treatment sequence for all annexation areas, regardless of location or implementation schedule within the planning area.

For the regional facilities, maintenance practices including man-hours, equipment, materials, and recommended frequencies were developed as a guide for City staff.

Many of the recommended regional stormwater management facilities and stormwater channels are situated in ESRAs. Because of this, there are opportunities to use capital investments in stormwater infrastructure to acquire ESRA property or to support projects identified in the *Springwater Community Plan Natural Resources Report*. The eleven natural resource projects identified in the community plan are listed at the bottom of Table ES-4. These projects, which will be important as the City recruits sustainable businesses and industries to locate in Springwater Community, address the following key objectives:

- Improving the headwater wetlands of McNutt Creek and riparian habitat along the tributaries of Johnson Creek
- Retaining undeveloped land as “green” wildlife corridors between the buttes and major tributaries of Johnson Creek
- Protecting the mature forests and riparian habitat within the five-creek confluence area in the southeastern part of the study area
- Preserving the integrity of large stands of mature forests
- Reconnecting the floodplains and riparian habitat along the Sunshine and Badger Creeks

Pleasant Valley

The Pleasant Valley public stormwater infrastructure projects were not prioritized based on weighted criteria because all the projects are infrastructure improvements that are required for stormwater management. Instead, the projects were organized by an implementation schedule based on the west-to-east annexation strategy provided in the Public Facility Plan. Exceptions to this approach were made when downstream projects occurred later in the annexation schedule. For example, when swale projects were adjacent to each other but in different annexation areas, they were combined into the earliest annexation period.

Sustainable Funding Sources

It is recommended that the City of Gresham continue to develop plans for obtaining sustainable funding sources for the proposed projects. The analysis and planning performed for the *Pleasant Valley Utility Master Plan Funding Analysis* and *Pleasant Valley Master Plan Funding Plan* (ECONorthwest, 2004) needs to be further developed and broadened to encompass the Johnson Creek and Springwater study areas. The City is currently performing a system development charge and utility rate study that should contribute to this effort.

TABLE ES-2
Johnson Creek Stormwater CIP Projects

CIP Group No.	Description	Total Drainage Area (acres)	Total Cost
ATG-1	Culvert Improvement - Atherton Ave.	85.9	$30,002
AVG-1	Pipe Improvement - Ava Ave. Group 1	122.6	868,781
BCG-1	Pipe Improvement - Butler Creek Group 1	35.5	309,099
BCG-2	Pipe Improvement - Butler Creek Group 2	53.2	143,082
BRG-1	Culvert Improvement - Brick Creek	52.4	61,956
BSG-1	Culvert Improvement - Butler South	507.1	229,773
BWG-3	Pipe Improvement - Butler West Group 3	76.9	207,775
CCG-1	Pipe Improvement - Cedar Creek Group 1	46.6	433,798
CCG-2	Culvert Improvement - Cedar Creek Group 2	78.8	84,611
MAG-1	Pipe Improvement - Mawcrest Dr.	46.9	60,756
MEG-1	Pipe Improvement - Miller Ct.	26.8	133,094
MOG-1	Pipe Improvement - Morlan Ave.	7.6	76,173
PEG-2	Pipe Improvement - Power East Blvd. Group 2	33.1	115,986
PLG-1	Pipe Improvement - Powell Loop Group 1	32.6	287,074
PLG-2	Pipe Improvement - Powell Loop Group 2	21.3	208,490
RBG-1	Pipe Improvement - Roberts Dr.	40.5	204,589
RCG-1	Culvert Improvement - Refner Creek	84.9	190,230
TEG-1	Pipe Improvement - Towle Ave. East Group 1	33.2	91,345
TEG-2	Pipe Improvement - Towle Ave. East Group 2	194.5	277,658
TSG-1	Pipe Improvement - Towle Ave. South	32.3	118,342
WAG-1	Culvert Improvement - Walters Dr.	24.7	41,212
NR01	SE 7th St. Riparian Corridor Restoration	--	293,525
NR02	East Gresham Grade School	--	134,238
NR03	SE Dowsett St. Riparian Corridor Restoration	--	185,148
NR04	Grace Community Church	--	130,062
NR05	Bus Creek Restoration	--	66,201
NR06	West Gresham Grade School	--	66,134
NR07	SW 14th St. Riparian Corridor Restoration	--	51,404
NR08	SE Gresham Riparian Corridor Restoration	--	517,439
NR09	Willowbrook Pond	--	25,711
Total Johnson Creek Stormwater CIP Cost			**$5,643,688**

TABLE ES-3
Springwater Stormwater CIP Projects

Annex Area	Project	Unit	Cost
1[a]	8-foot Swales (lf)	179	$1,538
	Regional Facilities	Hogan North	859,387
		Hogan South	616,639
		Brickyard	584,144
	Subtotal		**$2,061,707**
	Total Cost[b]		**$4,061,363**
2	8-foot Swales (lf)	8,249	$70,341
	Drainage Channels (lf)	4,125	38,447
	Swale Culverts (@ 30 inches each)	1	8,405
	Culverts (each)	Brigman-CV1	15,753
	Regional Facilities	Golf Course	605,217
		Hogan Creek	321,983
	Subtotal		**$1,060,145**
	Total Cost[b]		**$2,071,203**
3a	8-foot Swales (lf)	5,676	$48,397
	Drainage Channels (lf)	4,080	38,033
	Swale Culverts (each)	2	17,712
	Culverts (each)	Botefuhr-CV3	13,146
	Regional Facilities	Botefuhr West	453,984
	Subtotal		**$571,272**
	Total Cost[b]		**$1,110,159**
3b1	8-foot Swales (lf)	8,783	$74,891
	Drainage Channels (lf)	6,644	61,924
	Swale Culverts (each)	3	24,174
	Culverts (each)	Botefuhr-CV1	15,753
	Regional Facilities	Springwater Trail #1	753,424
		Botefuhr East	251,121
	Subtotal		$1,181,287
	Total Cost[b]		$2,304,159
3b2	8-foot Swales (lf)	12,339	$105,205
	Drainage Channels (lf)	3,380	31,509
	Swale Culverts (each)	3	25,214
	Culverts (each)	Brigman-CV3	13,146
		MidJC Main Stem-CV2	13,146
	Regional Facilities	Springwater Trail #3	412,859
		Springwater Trail #2	355,741
	Subtotal		$956,821
	Total Cost[b]		$1,860,468
4a	8-foot Swales (lf)	4,385	$37,396
	Drainage Channels (lf)	1,702	15,867
	Swale Culverts (each)	1	6,151
	Culverts (each)	McNutt-CV1	9,237
	Subtotal		**$68,650**
	Total Cost[b]		**$126,315**

TABLE ES-3
Springwater Stormwater CIP Projects

Annex Area	Project	Unit	Cost
4b	8-foot Swales (lf)	9,437	$80,470
	Swale Culverts (each)	2	12,301
	Culverts (each)	McNutt-CV2	13,146
	Regional Facilities	McNutt	861,948
	Subtotal		**$967,866**
	Total Cost[b]		**$1,892,926**
4c	8-foot Swales (lf)	7,332	$62,516
	Drainage Channels (lf)	3,839	35,783
	Swale Culverts (each)	8	58,466
	Culverts (each)	Sunshine-CV1	9,237
	Regional Facilities	Springwater Trail #4	432,182
		Rugg Road	823,860
	Subtotal		**$1,422,044**
	Total Cost[b]		**$2,779,846**
5a	8-foot Swales (lf)	7,706	$65,709
	Swale Culverts (each)	3	30,506
	Regional Facilities	Callister Road	801,679
	Subtotal		**$897,894**
	Total Cost[b]		**$1,756,344**
5b	8-foot Swales (lf)	9,041	$77,088
	10-foot Swales (lf)	4,814	47,924
	Drainage Channels (lf)	1,451	13,533
	Swale Culverts (each)	4	35,113
	Regional Facilities	Highway #1	1,053,786
		267th Ave	1,246,600
	Subtotal		**$2,474,044**
	Total Cost[b]		**$4,851,291**
5c	8-foot Swales (lf)	10,396	$88,644
	10-foot Swales (lf)	2,815	28,030
	Drainage Channels (lf)	2,258	21,052
	Swale Culverts (each)	2	12,301
	Culverts (each)	EastJC North Fork CV-2	15,753
	Regional Facilities	Carl Road	705,180
	Subtotal		**$870,961**
	Total Cost[b]		**$1,694,241**
6a	8-foot Swales (lf)	2,930	$24,987
	10-foot Swales (lf)	93	933
	Drainage Channels (lf)	3,485	32,489
	Swale Culverts (each)	1	12,447
	Culverts (each)	MidJC Main Stem-CV1	13,146
		EastJC North Fork-CV5	20,150
	Regional Facilities	Springwater Trail #5	683,458
	Subtotal		**$787,611**
	Total Cost[b]		**$1,538,053**

TABLE ES-3
Springwater Stormwater CIP Projects

Annex Area	Project	Unit	Cost
6b	8-foot Swales (lf)	6,164	52,557
	Drainage Channels (lf)	3,811	35,524
	Swale Culverts (each)	3	21,955
	Culverts (each)	East JC North Fork-CV1	13,146
		EastJC North Fork-CV2	9,237
	Subtotal		**$132,419**
	Total Cost[b]		**$243,651**
7a	8-foot Swales (lf)	3,489	$29,753
	Drainage Channels (lf)	2,575	24,003
	Swale Culverts (each)	1	12,447
	Regional Facilities	Jeanette Road	864,223
		Highway #2	287,845
	Subtotal		**$1,218,271**
	Total Cost[b]		**$2,391,388**
7b	Drainage Channels (lf)	3,449	$32,150
	Subtotal		**$32,150**
	Total Cost[b]		**$59,156**
8a[c]	8-foot Swales (lf)	3,534	$30,134
	Swale Culverts (each)	1	6,151
	Subtotal		**$36,285**
	Total Cost[b]		**$66,764**
8b[c]	8-foot Swales (lf)	1,354	$11,554
	Subtotal		**$11,554**
	Total Cost[b]		**$21,259**
Natural Resource Projects			
	Hogan Cedar Grove		$8,600,000
	Springwater Gateway Wetlands (Stone Rd./Hwy. 26) Enhancement		1,600,000
	Buttes with Slopes > 25%		6,000,000
	Hogan and Botefuhr Wildlife Corridor		600,000
	Sunshine and McNutt Wildlife Corridor		2,800,000
	Brigman Pond Removal and Enhancement		900,000
	McNutt Headwater Wetland Enhancement		400,000
	Johnson Creek Hwy. 26 Wetland Complex and Floodplain Reconnection		900,000
	North Fork Johnson Creek Riparian Enhancement		750,000
	Johnson Creek (Telford – Hwy. 26) Riparian Floodplain Reconnection		100,000
	Badger Creek Culvert Removal and Channel Enhancement[c]		670,000[c]
	Total NR Project Cost[d]		**$22,650,000[d]**
Total Gresham Springwater Stormwater CIP Cost			**$47,329,200**

[a]Brickworks area – not included in the Springwater Stormwater CIP Cost Total

[b]Equals the capital cost plus the following costs: mobilization (10 percent), construction contingency (30 percent), permitting for regional facilities (10 percent of the sum of the capital cost and the construction contingency), design and construction management (30 percent), and City administrative cost (14 percent)

[c]City of Damascus area

[d]Total NR Project Cost for projects within Gresham Annexation Area

lf = linear feet.

TABLE ES-4
Pleasant Valley Stormwater CIP Projects

	Annexation		Stormwater Improvement		
Implementation Schedule	Area	Subarea	Identification Number	Description	Cost
1	B PDX West	1A	Pond_JENRD_001	Regional Facility	$4,064,978
			JENRD_001A-1	Swale	Area to be in City of Portland
			JENRD_001A-2	Swale	
				Green Street Trees	
	A2 Northwest	2A	Pond_JENNE_011	Regional Facility	$265,391
			Pond_JENNE_021	Regional Facility	228,308
			JENNE_012-GS	Culvert	15,134
			JENNE_001A-1	Swale	332,091
			JENNE_011-1	Swale	224,708
			JENNE_012-1	Swale	9,348
				Green Street Trees	14,000
				Capital Cost	1,088,981
				Total Cost*	**$2,067,905**
2	A1 Northeast	3A	JENNE_023-GS	Culvert	$5,054
			JENNE_013-GS	Culvert	5,054
			JENNE_022-GS	Culvert	11,037
			JENNE_023_GS**	Culvert	5,054
			JENNE_022-1	Swale	2,856
			JENNE_022-2	Swale	215,581
			JENNE_013-N	Swale	2,025
			JENNE_023-N	Swale	2,337
			JENNE_013-1	Swale	224,648
			JENNE_023-1	Swale	3,428
			172N_042-1	Swale	107,440
			172N_042-2	Swale	2,077
			LOWER_022-N	Swale	4,051
				Green Street Trees	14,000
				Capital Cost	599,588
				Total Cost*	**$1,112,542**
3	A2 Northwest	2B	CONF_031-GS	Culvert	$5,054
			CONF_012-GS	Culvert	6,015
			CONF_012-1	Swale	2,337
			CONF_021-1	Swale	4,674
			CONF_031-2	Swale	4,622
			CONF_012-2	Swale	5,089
			CONF_031-1	Swale	4,258
				Green Street Trees	14,000
				Capital Cost	46,050
				Total Cost*	**$84,732**

TABLE ES-4
Pleasant Valley Stormwater CIP Projects

	Annexation		Stormwater Improvement		
Implementation Schedule	Area	Subarea	Identification Number	Description	Cost
4	A2 Northwest	2D	Pond_172N_001	Regional Facility	$236,443
			172N_011-GS	Culvert	8,949
			172N_011-1	Swale	96,452
			172N_001-1	Swale	144,068
			172N_011-2	Swale	283,898
				Green Street Trees	14,000
				Capital Cost	783,810
				Total Cost*	$1,472,948
5	A2 Northwest	2C	172N_014-GS	Culvert	$6,015
			172N_021-1	Swale	122,091
			172N_021-2	Swale	3,687
			172N_014-1	Swale	4,051
			172N_022B-1	Swale	2,077
				Green Street Trees	14,000
				Capital Cost	151,922
				Total Cost*	**$279,536**
6	A1 Northeast	3B	Pond_Lower_001A	Regional Facility	$176,413
			Pond_172N_014	Regional Facility	813,557
			172N_032B-GS	Culvert	6,015
			LOWER_022-GS	Culvert	8,949
			LOWER_001A-1	Swale	2,545
			LOWER_011B-1	Swale	2,700
			LOWER_011B-N	Swale	2,597
			LOWER_012-1	Swale	81,580
			LOWER_021-1	Swale	61,046
			172N_013-1	Swale	7,530
			172N_013-2	Swale	1,143
			172N_022A-1	Swale	935
			172N_023-1	Swale	1,973
			172N_023-2	Swale	1,610
			172N_032C-1	Swale	4,882
			172N_032B-1	Swale	2,337
			172N_032A-1	Swale	1,662
			LOWER_022-1	Swale	7,634
				Green Street Trees	14,000
				Capital Cost	1,199,107
				Total Cost*	**$2,335,052**

TABLE ES-4
Pleasant Valley Stormwater CIP Projects

	Annexation		**Stormwater Improvement**		
Implementation Schedule	**Area**	**Subarea**	**Identification Number**	**Description**	**Cost**
	A3 Central	4A	Pond_172S_001A	Regional Facility	$153,601
			172S_021C-GS	Culvert	5,054
			172S_021D-GS	Culvert	5,054
			172S_041-GS	Culvert	5,054
			172S_013-GS	Culvert	20,452
			172S_051-GS	Culvert	9,247
			172S_011A-1	Swale	4,310
			MITCH_011C-1	Swale	8,153
			MITCH_001B-1	Swale	4,362
			LOWER_001B-1	Swale	779
			172S_022-2	Swale	1,246
			172S_021C-1	Swale	6,595
			172S_022-1	Swale	2,337
			172S_021D-1	Swale	987
			172S_021A-1	Swale	2,649
			172S_021B-1	Swale	5,972
			172S_041-1	Swale	6,959
			172S_032-N	Swale	3,012
			172S_031-1	Swale	10,594
			172S_031-2	Swale	310,217
			172S_051-1	Swale	143,261
				Green Street Trees	14,000
				Capital Cost	723,898
				Total Cost*	**$1,351,940**
7	A1 Northeast	3C	Pond_Route_Lower Head	Regional Facility	$633,571
			LOWER_022-2	Swale	9,296
			LOWER_012-2	Swale	15,424
				Green Street Trees	14,000
				Capital Cost	672,291
				Total Cost*	**$1,319,379**
8	A3 Central	1D	Pond_MITCH_001B	Regional Facility	$250,849
			MITCH_011C-GS	Culvert	6,015
			MITCH_011B-1	Swale	9,815
			MITCH_021B-1	Swale	74,476
			172S_013-2	Swale	3,064
				Green Street Trees	14,000
				Capital Cost	358,219
				Total Cost*	**$691,734**

TABLE ES-4
Pleasant Valley Stormwater CIP Projects

	Annexation		Stormwater Improvement		
Implementation Schedule	**Area**	**Subarea**	**Identification Number**	**Description**	**Cost**
9	A3 Central	4C	Pond_172S_022	Regional Facility	$120,789
			Pond_Lower_013	Regional Facility	567,405
			LOWER_011A-1	Swale	2,545
			LOWER_013-1	Swale	183,139
			172S_032-2	Swale	4,830
			172S_032-1	Swale	3,220
			172S_042-2	Swale	2,597
			172S_042-1	Swale	2,597
			172S_061-1	Swale	215,581
				Green Street Trees	14,000
				Capital Cost	1,116,702
				Total Cost *	**$2,144,197**
	B PDX West	1B	Pond_MITCH_011A	Regional Facility	**$3,690,511**
			Pond_MITCH_031C	Regional Facility	**Area to be included in City of Portland**
			CLAT_012-GS	Culvert	
			MITCH_011D-GS	Culvert	
			MITCH_021C-GS	Culvert	
			MITCH_031C-GS	Culvert	
			CONF_011-GS	Culvert	
			CONF_011-1	Swale	
			CONF_011-2	Swale	
			CLAT_011A-1	Swale	
			CLAT_011B-1	Swale	
			CLAT_012-1	Swale	
			MITCH_011D-2	Swale	
			MITCH_011A-1	Swale	
			MITCH_011D-1	Swale	
			MITCH_021C-N	Swale	
			MITCH_021C-1	Swale	
			MITCH_031C-1	Swale	
			MITCH_031C-2	Swale	
				Green Street Trees	
10	C South	5A	Pond_Route_172A	Regional Facility	$2,361,857
			172S_023-GS	Culvert	8,949
			MITCH_031A-1	Swale	1,766
			MITCH_031B-1	Swale	4,830
			172S_013-1	Swale	268,457
			172S_023-1	Swale	265,813
			172S_023-2	Swale	4,155
			172S_023-N	Swale	2,649

TABLE ES-4
Pleasant Valley Stormwater CIP Projects

Implementation Schedule	Annexation Area	Annexation Subarea	Stormwater Improvement Identification Number	Stormwater Improvement Description	Cost
			172S_071-1	Swale	333,309
				Green Street Trees	14,000
				Capital Cost	3,265,783
				Total Cost*	**$6,316,082**
					Area to be included in the City of Happy Valley
		4B	Pond_172S_031	Regional Facility	$348,233
			172S_071-2	Swale	2,285
				Green Street Trees	14,000
				Capital Cost	364,518
				Total Cost	**$715,983**
					Area to be included in the City of Happy Valley
		4D	LOWER_013-2	Swale	$9,296
				Green Street Trees	14,000
				Capital Cost	23,296
				Total Cost*	**$42,865**
					Area to be included in the City of Happy Valley
Total Gresham Pleasant Valley Stormwater CIP Cost*					**$12,859,965**

*Total cost equals the capital cost plus the following costs:

- Mobilization (10 percent)
- Construction contingency (30 percent)
- Permitting for regional facilities (10 percent of the sum of the capital cost and the construction contingency)
- Design and construction management (30 percent)
- City administrative cost (14 percent)

**Duplicate identification number, but separate culvert.

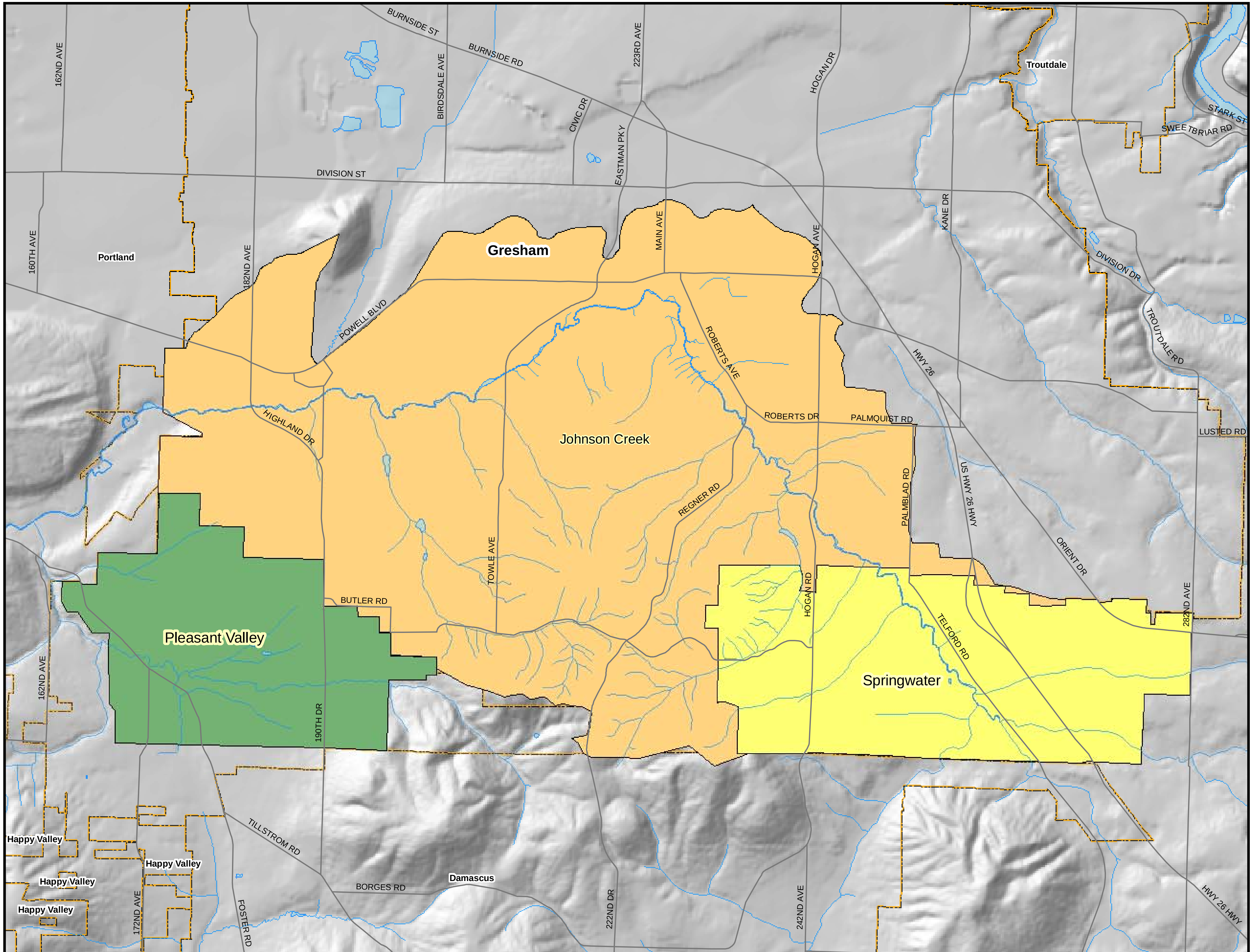

Figure ES-1

Basin Site Map

Johnson Creek Basin Stormwater Master Plan Executive Summary including Springwater and Pleasant Valley Areas

Legend

Major Roads

- Freeways
- Major Streets
- Rivers and Streams
- Lakes/Ponds/Rivers
- Springwater Study Area Boundary
- Pleasant Valley Study Area Boundary
- Johnson Creek Study Area Boundary
- Cities

N

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CH2MHILL

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Figure

ES-2 Johnson Creek Pipe and Culvert Replacement CIP Projects
11 x 17 color

Front

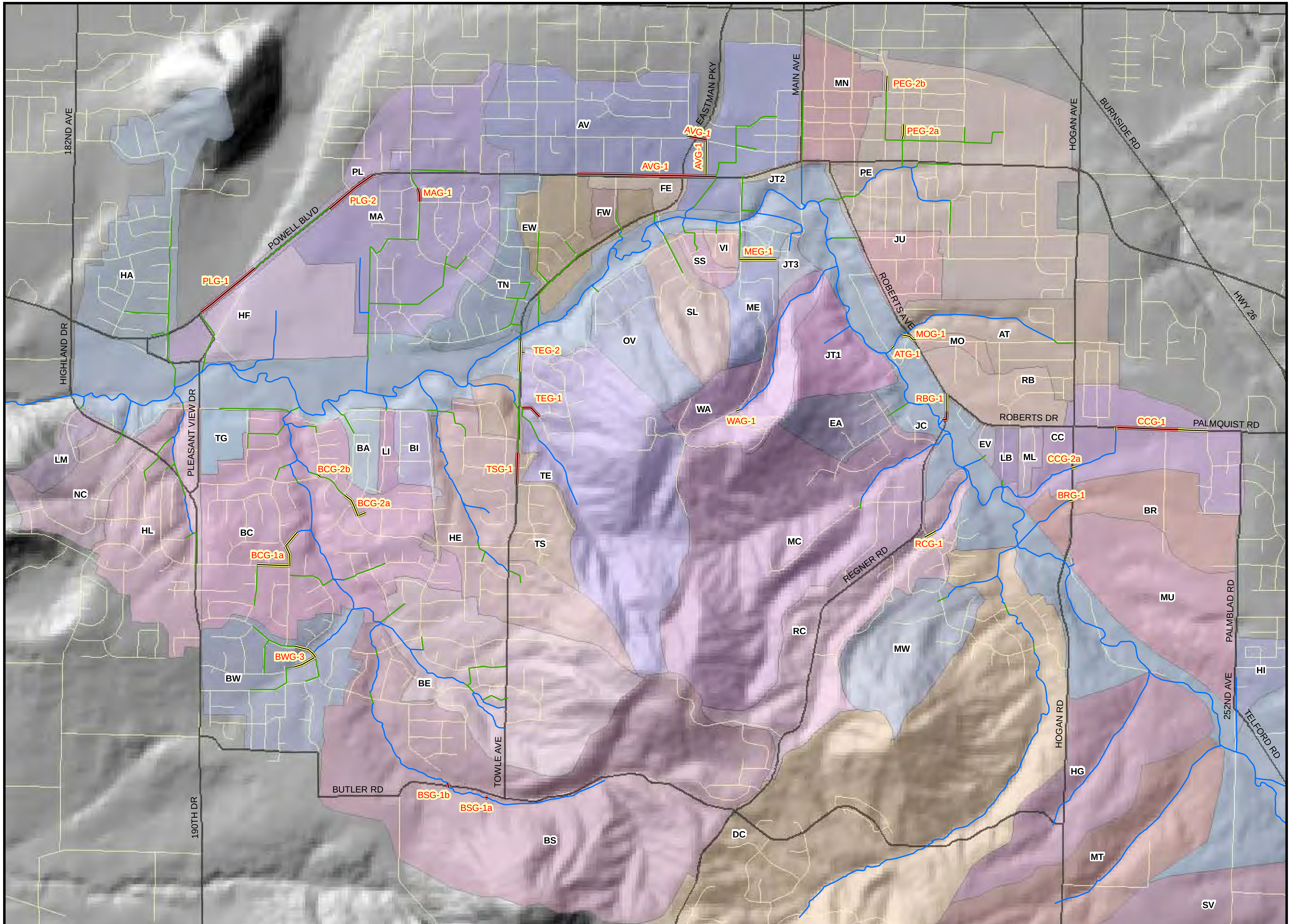

Figure ES-2

Johnson Creek Pipe and Culvert Replacement CIP Projects

Johnson Creek Basin Stormwater Master Plan Executive Summary including Springwater and Pleasant Valley Areas

Legend

- 10 Year Design Criteria
- 50 Year Design Criteria
- Streets
- Streams
- Stormwater Pipelines
- Subbasin
- Major Roads

N

700 0 700 1,400 Feet

CH2MHILL

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Back

Figure

ES-3 Johnson Creek Natural Resource Enhancement CIP Projects
11 x 17 color

Front

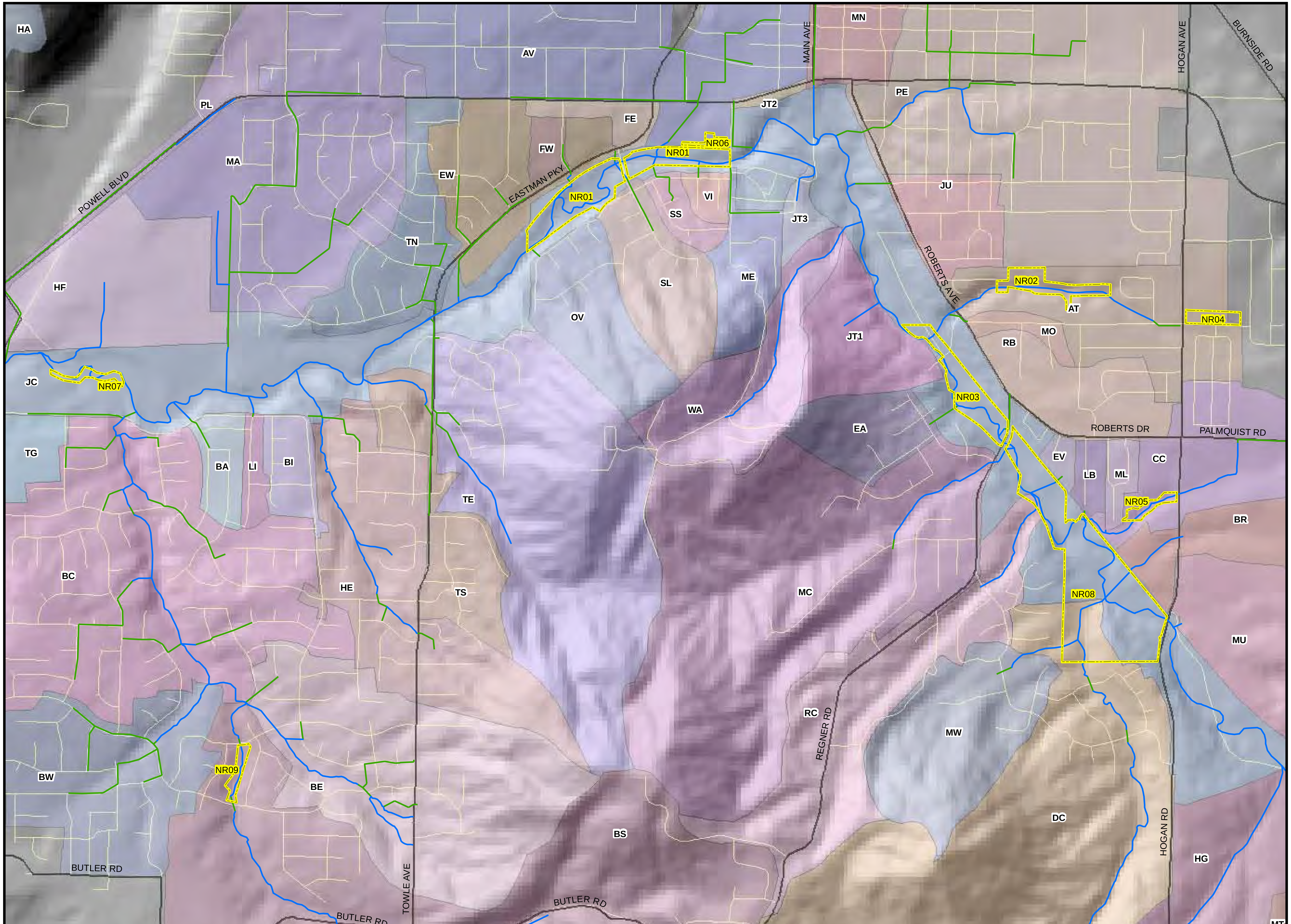

Figure ES-3

Johnson Creek Natural Resource Enhancement CIP Projects

Johnson Creek Basin Stormwater Master Plan Executive Summary including Springwater and Pleasant Valley Areas

Legend

- Streets
- Major Roads
- Streams
- Stormwater Pipelines
- Natural Resource Planting Areas
- Subbasin

N

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Back

Figure

ES-4 Springwater CIPs
11 x 17 color

Front

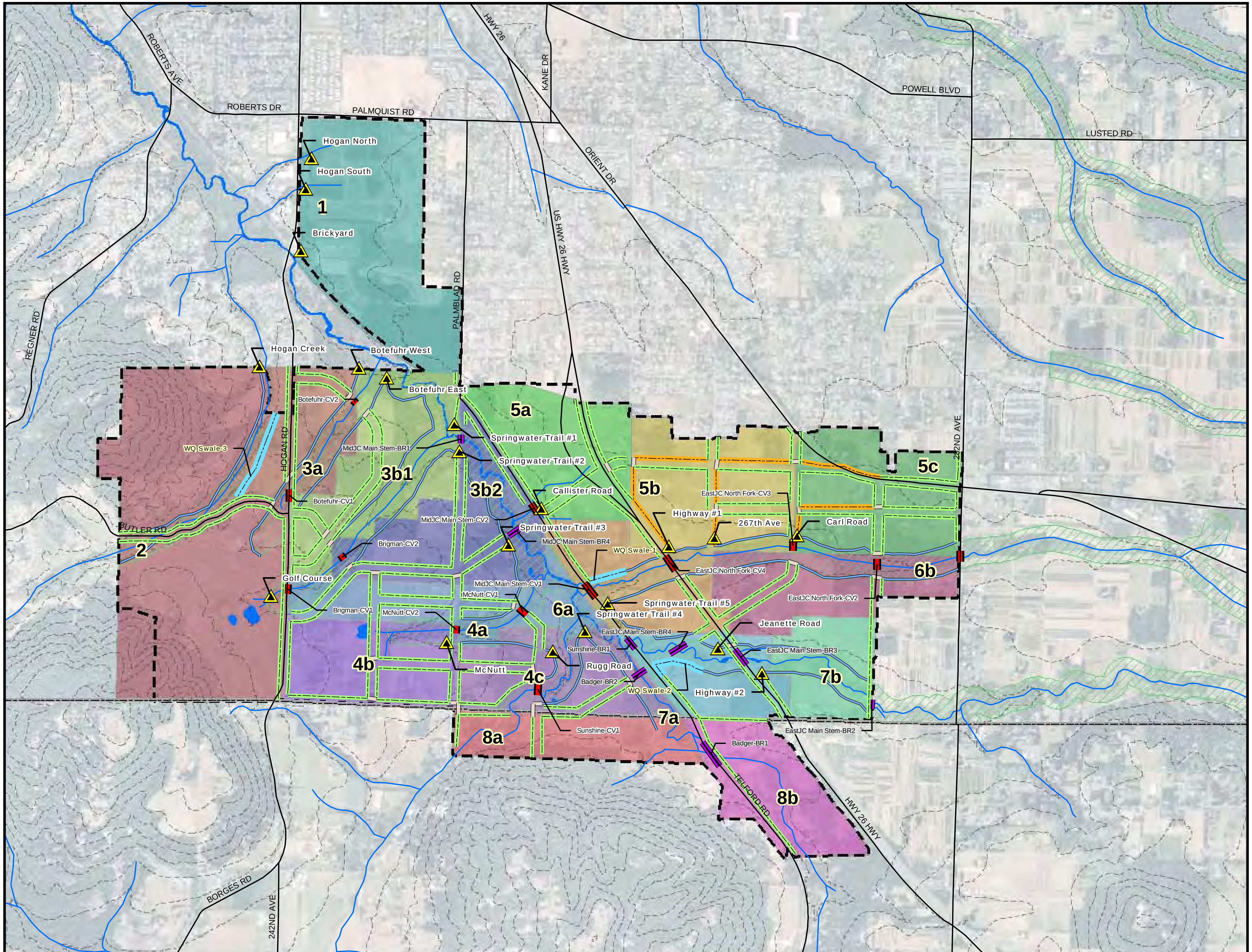

Figure ES-4

Springwater CIPs

Johnson Creek Basin Stormwater Master Plan Executive Summary including Springwater and Pleasant Valley Areas

Legend

- Regional Ponds
- 10' Street Swales
- Culverts
- Bridge
- Water Quality Swales
- Drainage Channels
- Swale Culverts
- 8' Street Swale
- Swale Culvert

Major Roads

- Freeways
- Major Streets
- Rivers and Streams
- Contours (50 foot)
- County Boundary
- Springwater Boundary
- ESRA
- Lakes/Ponds/Rivers

Annexation Areas

1, 2, 3a, 3b1, 3b2, 4a, 4b, 4c, 5a, 5b, 5c, 6a, 6b, 7a, 7b, 8a, 8b

N

1 inch equals 1,500 feet

800 0 800 1,600 Feet

CH2MHILL

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Back

Figure

ES-5 Springwater Natural Resource Protection Restoration Plan
8½ x 11 color

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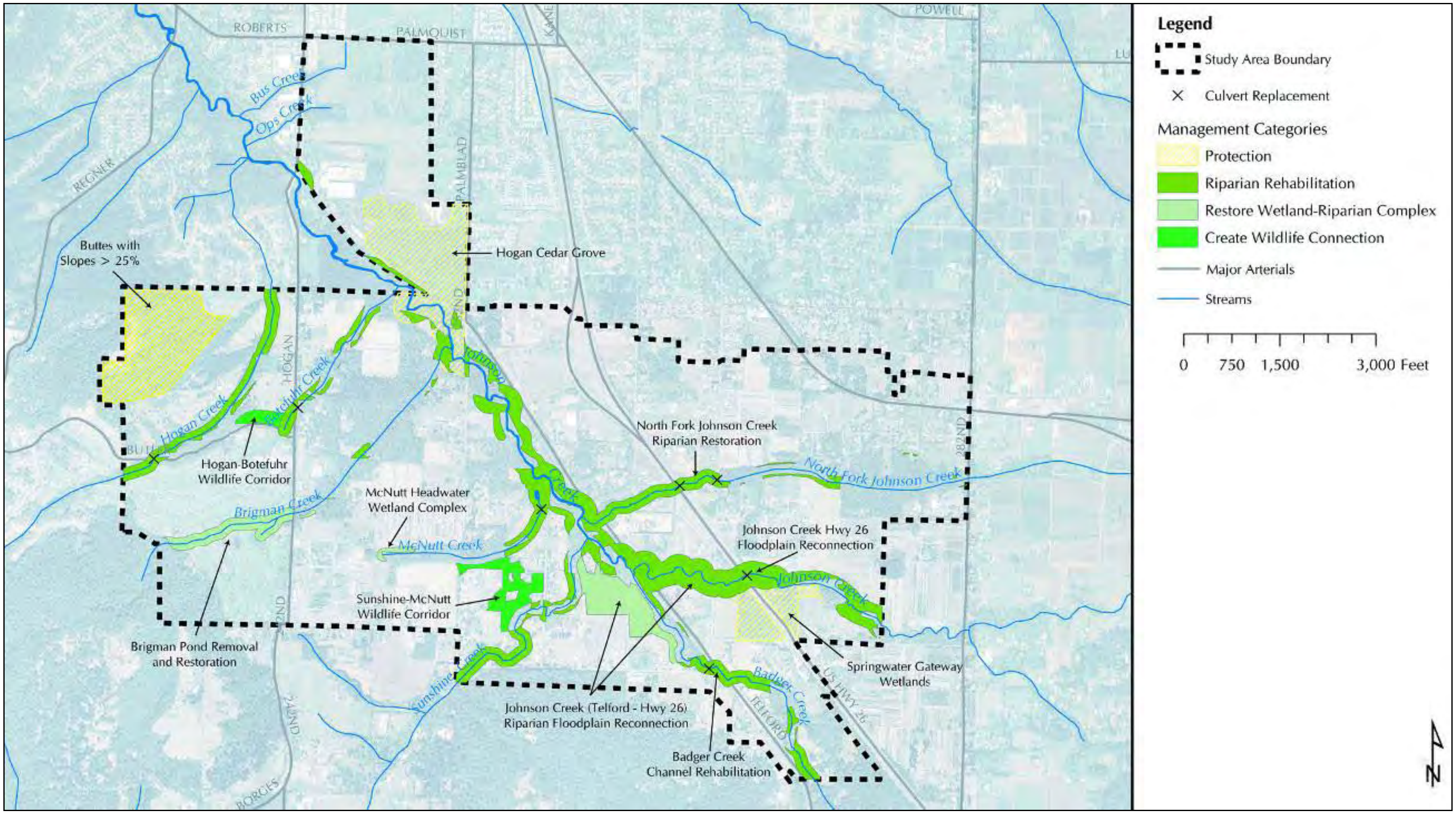

FIGURE ES-5
Springwater Natural Resource Protection and Restoration Plan

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Figure

ES-6 Pleasant Valley Green Street Swale and Culvert CIP Projects
11 x 17 color

Front

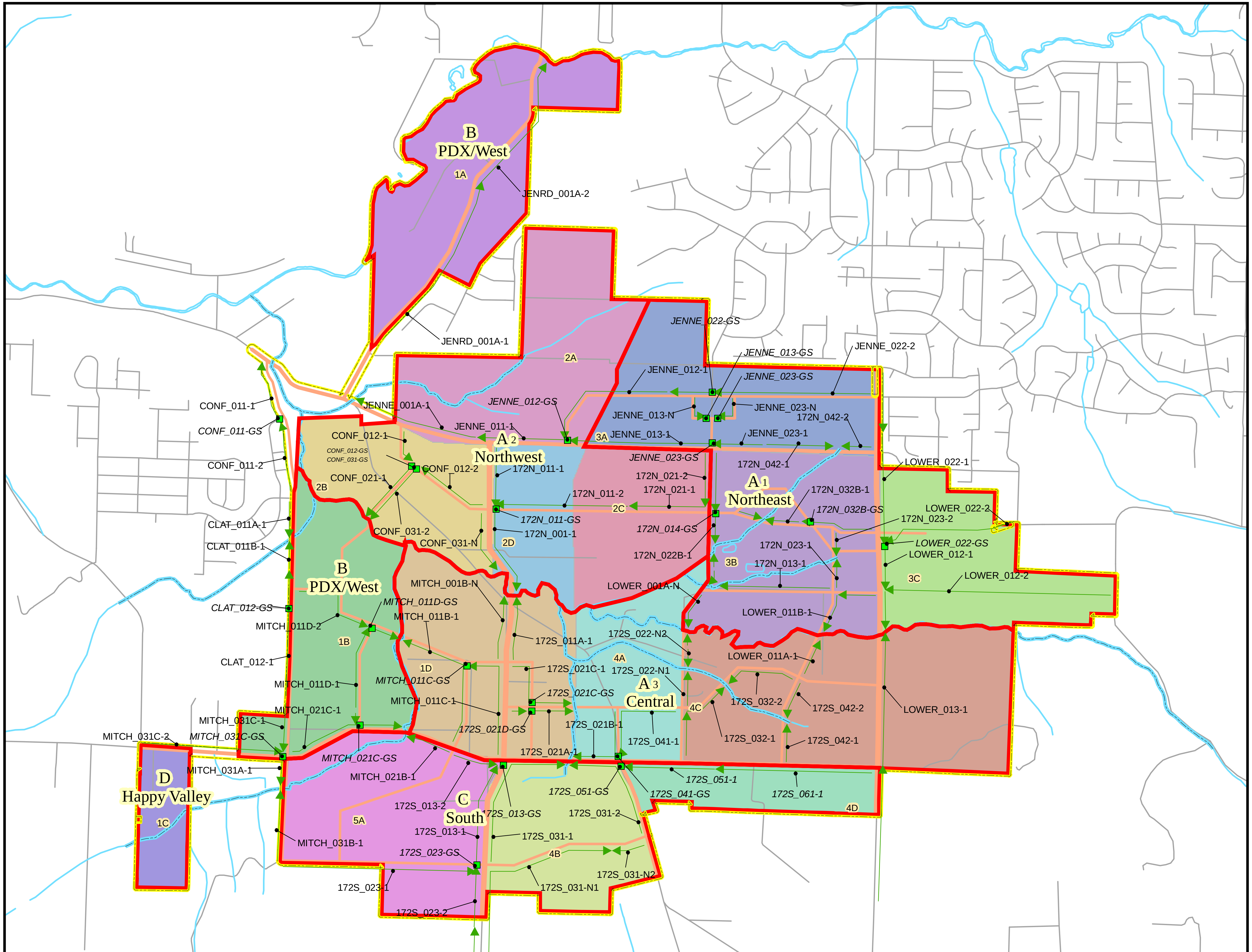

Figure ES-6

Pleasant Valley Green Street Swale and Culvert CIP Projects

Johnson Creek Basin Stormwater Master Plan Executive Summary including Springwater and Pleasant Valley Areas

Legend

- CIP Green Street Culverts (modeled)
- CIP Green Street Swales (modeled)
- Modeled Streams
- Streams (not modeled)
- Plan District Boundary
- Major Arterial
- Minor Arterial
- Collector
- Neighborhood Connector
- Existing Streets
- Annexation Areas **C South**

Annexation Subareas

1A	3A
1B	3B
1C	3C
1D	4A
2A	4B
2B	4C
2C	4D
2D	5A

N

600 0 600 1,200 Feet

CH2MHILL

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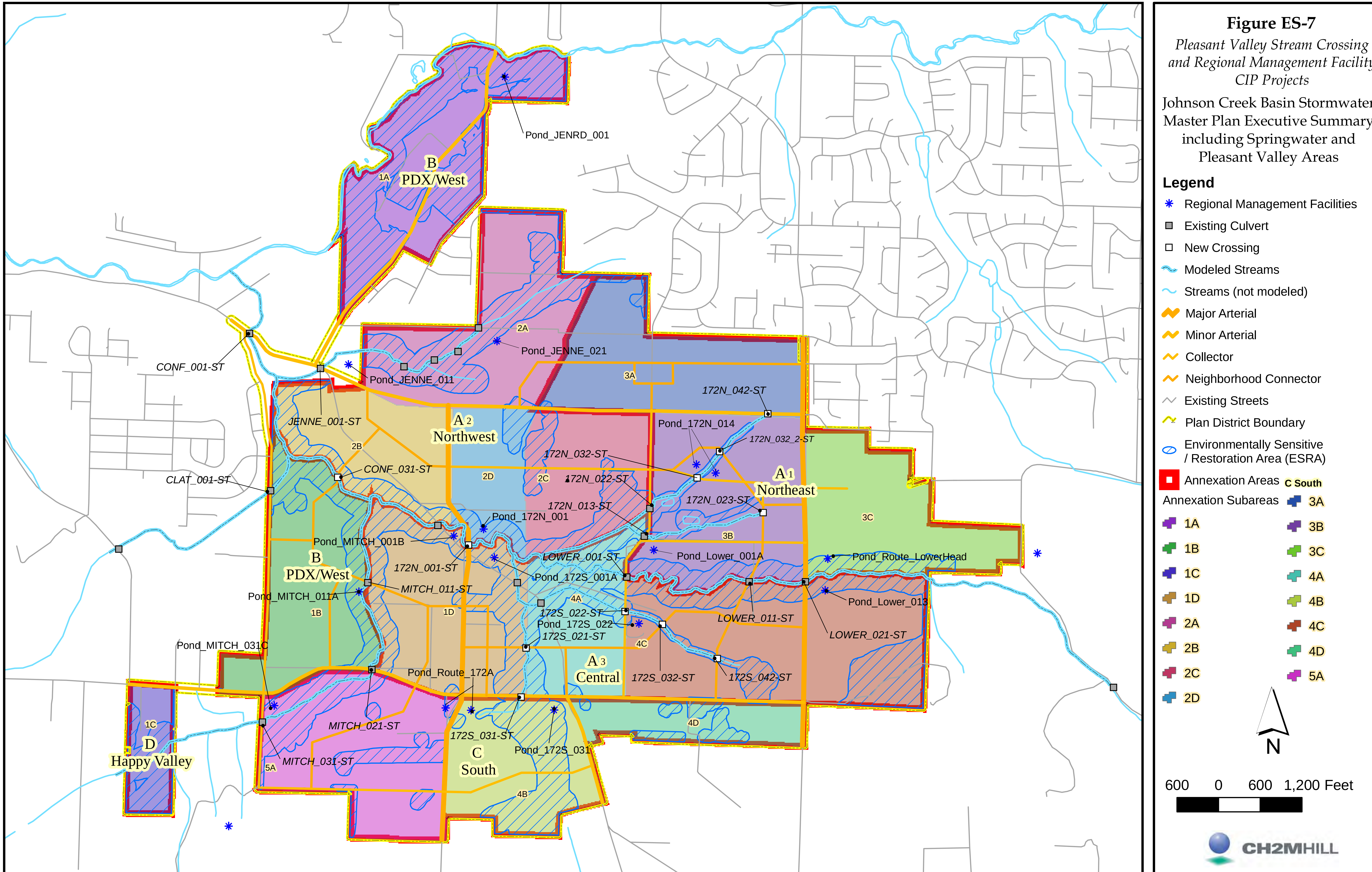
Figure

ES-7 Pleasant Valley Stream Crossing and Regional Management Facility CIP Projects
11 x 17 color

Front



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For a full copy of this Master Plan please contact Robin Pederson at the Department of Environmental Services, 503-618-2130 or robin.pederson@GreshamOregon.gov